

# Coastal Engineering Technical Note



## LEO LITTORAL ENVIRONMENT OBSERVATIONS

By Leonette J. Thomas and William C. Seabergh

### PURPOSE

The objective of this Coastal Engineering Technical Note is to describe the Littoral Environment Observation (LEO) measurement system and the tools available for District Offices to implement their own LEO data collection program. LEO provides low-cost coastal data for the planning, design, operation, and maintenance of coastal works.

LEO consists of systematic collection of wind, wave, and current data visually obtained by volunteer observers. LEO data are collected primarily at sites where little or no wave data exist, where resources are not available for installation of recording instruments, or where daily measurements such as beach width are desired. Over 360 LEO collection stations have been established on U.S. coasts. Data from previous LEO data collection efforts are available at each District office and some limited LEO data are available in the CEDARS database (reference CETN-I-23).

### TYPES OF LITTORAL VARIABLES OBSERVED AND RECORDED

The LEO field measurements typically recorded are shown in Figures 1 and 2 (LEO recording form). Visual estimates are made of the wave period, breaker height, wave type, and width of surf zone. A protractor, shown in Figure 2, is used to estimate the direction from which the waves are approaching. The wind direction is noted on an 8-point compass. Windspeed is measured by a hand-held wind meter. A hand level is used to estimate the foreshore slope. The spacing of any observed rip currents (strong surface currents flowing seaward from the shore) and beach cusps (low mounds of sand separated by crescent-shaped troughs) are recorded. Littoral current speed and direction are measured by injecting dye and measuring its movement alongshore for a period of 1 min. The alongshore current can then be determined. The instruments mentioned earlier (wind meter and hand level) and environmentally safe dye can be obtained from sources noted prior to the references.

In addition, the observer may take sand samples of the material on the beach if this type of data is required and may also measure beach width. Remarks and comments by the observer regarding unusual beach weather or ocean conditions are recorded. LEO observations are usually taken once (or twice) a day, and sand samples are re-collected once a month.

<b>LITTORAL ENVIRONMENT OBSERVATIONS</b> <b>RECORD ALL DATA CAREFULLY AND LEGIBLY</b>														
<b>SITE NUMBERS</b> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px;"> <span>1 2 3 4 5</span> </div>					<b>YEAR</b> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px;"> <span>6 7</span> </div>		<b>MONTH</b> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px;"> <span>8 9</span> </div>		<b>DAY</b> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px;"> <span>10 11</span> </div>		<b>TIME</b> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px;"> <span>12 13 14 15</span> </div>			
<b>WAVE PERIOD</b> <small>Record the time in seconds for eleven (11) wave crests to pass a stationary point. If calm record 0.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>16 17 18</span> </div>					<b>BREAKER HEIGHT</b> <small>Record the best estimate of the average wave height to the nearest length of a foot.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>19 20 21</span> </div>									
<b>WAVE ANGLE AT BREAKER</b> <small>Record to the nearest degree the direction the waves are coming from using the protractor on the following page. 0 if calm</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>22 23 24</span> </div>					<b>WAVE TYPE</b> <div style="display: flex; justify-content: space-between; font-size: 8px; margin-top: 10px;"> <div>           0-Calm            1-Spilling            2-Plunging         </div> <div>           3-Surging            4-Spill/Plunge         </div> </div> <div style="text-align: right; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div> <div style="font-size: 8px; margin-top: 5px;">25</div> </div>									
<b>WIND SPEED</b> <small>Record wind speed to the nearest mph. If calm record 0.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>26 27</span> </div>					<b>WIND DIRECTION</b> <small>Direction the wind is coming from.</small> <div style="display: flex; justify-content: space-between; font-size: 8px; margin-top: 10px;"> <div>1-N 2-NE 3-E 4-SE 5-S 6-SW 7-W 8-NW</div> <div>0-Calm</div> </div> <div style="text-align: right; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div> <div style="font-size: 8px; margin-top: 5px;">28</div> </div>									
<b>FORESHORE SLOPE</b> <small>Record foreshore slope to the nearest degree.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>29 30</span> </div>					<b>WIDTH OF SURF ZONE</b> <small>Estimate in feet the distance from shore to breakers, if calm record 0.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>31 32 33 34</span> </div>									
<b>LONGSHORE CURRENT</b>  <b>CURRENT SPEED</b> <small>Measure in feet the distance the dye patch is observed to move during one minute period; if no longshore movement record 0.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>43 44 45</span> </div>					<b>DYE</b> <small>Estimate distance in feet from shoreline to point of dye injection.</small> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <div style="display: flex; justify-content: space-around; font-size: 8px; margin-top: 5px;"> <span>36 37 38</span> </div> <b>CURRENT DIRECTION</b> <div style="font-size: 8px; margin-top: 10px;">           0 No longshore movement            +1 Dye moves toward right            -1 Dye moves toward left         </div> <div style="text-align: right; margin-top: 10px;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div> <div style="font-size: 8px; margin-top: 5px;">46 47</div> </div>									

NES FORM 2387, R Aug 84

PREVIOUS EDITIONS OBSOLETE.

Figure 1. LEO Recording Form (front view)

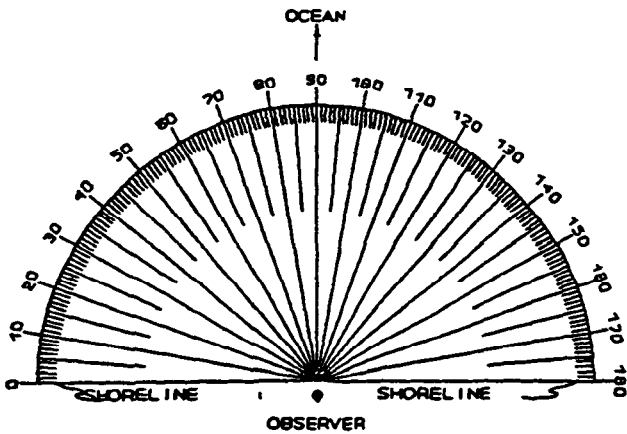
<p><b><u>RIP CURRENTS</u></b></p> <p>If rip currents are present, indicate spacing (feet). If spacing is irregular estimate average spacing. If no rips record 0.</p> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> </div> <p style="text-align: center; margin: 0;">49 50 51 52</p>	
<p><b><u>BEACH CUSPS</u></b></p> <p>If cusps are present, indicate spacing (feet). If spacing is irregular estimate average spacing. If no cusps record 0.</p> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> </div> <p style="text-align: center; margin: 0;">54 55 56</p>	<p><b><u>BEACH WIDTH</u></b></p> <p>Measure the distance of the most seaward Beach Berm crest from a reference point to the nearest foot.</p> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> <div style="border: 1px solid black; width: 20px; height: 15px; margin: 0 2px;"></div> </div> <p style="text-align: center; margin: 0;">57 58 59 60</p>
<p><b>PLEASE PRINT:</b></p> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%; border-bottom: 1px solid black; text-align: center;"> <p>SITE NAME</p> </div> <div style="width: 45%; border-bottom: 1px solid black; text-align: center;"> <p>OBSERVER</p> </div> </div> <p style="text-align: center; margin: 10px 0;"><i>Please Check The Form For Completeness</i></p> <p><b>REMARKS:</b></p> <div style="border-bottom: 1px solid black; height: 15px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 15px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 15px;"></div>	
 <p style="font-size: small; margin-top: 10px;">NOTE: If a pier is used for an observation platform: place 0-180 line on the rail parallel to the centerline of the pier. Sight along the crest of the breaking waves and record the angle observed</p>	

Figure 2. LEO Recording Form (back view)

Data collected from each site are compiled and summarized. Daily records are statistically summarized into monthly and yearly averages. This data can be useful in describing the beach environment at a particular site. Observer bias for high or low readings can be partially compensated for by looking at relative changes, rather than at the absolute values of certain parameters.

## **APPLICABILITY**

The tabulated LEO data are useful for planning, design, operation, and maintenance of coastal facilities. While the data may not be as accurate as those obtained from recording sensors such as wave gauges and current meters, it is obtained at a relatively low cost. Because of this, it can often be obtained when instrumented information cannot. LEO data generally provide a wider suite of information than do an instrument station. LEO provides input for the following principal study items that can be used in solving coastal problems.

- |   |   |
|---|---|
| 1. Geomorphology                        | 7. Littoral transport (direction, amount, and character). |
| 2. Material characteristics             | 8. Effects of inlets.                                     |
| 3. Winds and storms                     | 9. Zoning considerations.                                 |
| 4. Waves and currents                   |   |
| 5. Ice conditions                       |   |
| 6. Shoreline and offshore depth changes |   |

Comparison of the various beach material parameters for many beach locations should result in additional understanding of the geomorphology of a particular site, when correlated with all the other observed data. This can enhance the understanding of shore dynamics in relation to the materials composing the beach.

One of the several useful applications of LEO data is the prediction of longshore transport rates from waves breaking at an angle to the shoreline (item 7 above). These waves produce a longshore current, which, when coupled with the breaking wave turbulence, will suspend sediment and transport sand along the shore. LEO longshore current values allow computation of the longshore energy flux, which allows prediction of the longshore sand transport. Recent comparisons between two independent observers at a single LEO site suggest that more consistency exists for transport rates computed from their observations of longshore current velocity than from their observations of wave height and angle.

Compilations of the observed data on surf characteristics and beach response are also useful for studies directed primarily toward the recreational aspects of the shore. The ability to predict the overall characteristics of a beach for such uses as swimming and surfing will allow the appropriate agencies to assign various classifications of safety on use of the beaches.

## DATA ANALYSIS

A program, Littoral Environment Observation (LEO) PC Data Retrieval and Analysis System, is available for PC on a 3.5 in. diskette along with the "User's Guide for the Littoral Environment Observation (LEO) PC Data Retrieval and Analysis System" (Thomas 1994). Both may be obtained from the local Corps of Engineers District, along with an instructional video showing how LEO data are obtained. A listing of LEO data sites where previous LEO data were collected is shown in Table 1.

The PC program can analyze the previous LEO data (Table 1) or new data, if they are contained in an ASCII text file with each line of data placed in the order as shown in the LEO recording form (Figures 1 and 2). The program can produce summary tables and percent occurrence tables of the measurements and also compute longshore sediment movement rates. See Thomas (1994) for further details.

## SOURCES OF EQUIPMENT

### Dwyer Handheld Windmeter, Stopwatch, Hand Level, Compass

Forestry Suppliers, Inc.

205 W. Rankin St.

P.O. Box 8397

Jackson, MS 39284-8397

Phone: 1-800-647-5368 Fax: 1-800-543-4203

- Dwyer Handheld Windmeter - Catalog No. 89001 - \$14.25
- Digital Stopwatch - Catalog No. 92627 - \$32.75
- Abney Level - Catalog No. 43922 - \$65.90
- Compass - Catalog No. 37017 - \$18.50

### Powdered Dye (Uranine Concentrate Dye-yellow)

Tricon Colors, Inc.

16 Leliarts Lane

Elmwood Park, NJ 07407

Phone: 201-794-3800

- \$10.70 per pound
- repacked in 100 pound drum - repacking fee for smaller quantity

### Slingshot, stopwatch, and compass can probably be purchased locally

Ideally the compass should have eight points identified, ie., N, NE, E, SE, SW, W and NW.

## REFERENCE

Thomas, L.J. (1994). "User's guide for the littoral environment observation (LEO) PC data retrieval and analysis system," Instruction Report CERC-94-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

## BIBLIOGRAPHY

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Bruno, R.D., and Hiipakka, L.W. (1973). "Littoral environment observation program in the state of Michigan." *Proceedings of the 16th Conference on Great Lakes Research*, International Association of Great Lakes Research, 492-507.

DeWall, A.E. (1977). "Littoral environment observations and beach changes along the southwest Florida coast," Technical Paper 77-10, Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Schneider, C. (1981). "The littoral environment observation (LEO) data collection program," Coastal Engineering Technical Aid 81-5, Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Sherlock, A.R., and Szuwalski, A. (1987). "A user's guide to the littoral environment observation retrieval system," Instruction Report CERC-87-3, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

*Shore protection manual*. (1984). 4th ed., 2 Vol, U.S. Army Engineer Waterways Experiment Station, U.S. Government Printing Office, Washington, DC.

Smith, E.R., and Wagner, S.E. (1991). "Littoral environment observation program," *Journal of Coastal Research* 7(3), 595-605.

# TABLE 1: LEO SITE LOCATIONS

SITE	LOCATION	ST	SITE	LOCATION	ST	SITE	LOCATION	ST
02001	KOTZEBUE WAY	AK	05565	SOLONA BEACH	CA	12081	ST. AUGUSTINE	FL
02002	SHORE LANE	AK	05566	ORTEGA	CA	12090	SANTAL ROASA ISLANDS	FL
02006	NINILCHIK	AK	05567	TARAVAL	CA	12101	CRYSTAL	FL
02007	HOMER SPIT	AK	05568	SLOAT	CA	12104	CAMP HELEN	FL
02009	HOMER SPIT	AK	05569	FULTON	CA	12105	ST. ANDREWS	FL
02015	HOMER SPIT	AK	05570	IRVING	CA	12110	GRAYTON	FL
02016	HOMER SPIT	AK	05595	CASSIDY STREET	CA	12115	J.C. BEASLEY	FL
02022	HOMER SPIT	AK	05596	WITHERBY STREET	CA	12118	NAVARRE	FL
02044	HOMER SPIT	AK	05597	WISCONSIN TOWER	CA	12120	FT. PICKENS	FL
02054	HOMER SPIT	AK	05598	MUNICIPAL PIER	CA	12895	REDINGTON SHORES	FL
05001	NEW BRIGHTON	CA	05599	HARBOR BEACH	CA	12897	PANAMA CITY	FL
05002	THORNTON BEACH	CA	05700	NEWPORT BEACH	CA	12898	BASIN BAYOU STATE PK	FL
05003	FRANCIS BEACH	CA	05701	OFFICER'S PIER	CA	12900	MEXICO BEACH, EAST	FL
05004	NATURAL BRIDGES	CA	05702	PEG NAVY (PT MUGU)	CA	12901	MEXICO BEACH, WEST	FL
05005	TWIN LAKES	CA	05703	PEG PIER (CERC)	CA	13002	SAPELO IS. PROFILE #2	GA
05006	SEA CLIFF	CA	05704	BALBOA BEACH	CA	13005	SAPELO IS. PROFILE #5	GA
05007	SUNSET BEACH	CA	05706	PEG 1000" SOUTH	CA	13101	TYBEE LIGHTHOUSE	GA
05009	SAN SIMON	CA	05707	PEG 1000" NORTH	CA	13102	DESOTO MOTEL	GA
05012	PISMO BEACH	CA	05712	SILVER STRAND NORTH	CA	13103	POLICE STATION	GA
05013	EL CAPTAN	CA	05713	NET-SOUTH	CA	13107	NORTH BEACH	GA
05014	CARPENTERIA	CA	05714	MID-NET	CA	13108	WANDERER	GA
05015	SAN BUENAVENTURA	CA	05715	NET-NORTH	CA	13109	BUCCANEER	GA
05017	LEO CARRILLO	CA	05720	MANDALAY BEACH	CA	13110	SOUTH WATER TOWER	GA
05018	BOLSA CHICA	CA	05725	PIERPONT BAY	CA	13111	EAST BEACH	GA
05019	FT. MUGU REC AREA	CA	05735	HOBBSON BEACH	CA	13112	COAST GUARD	GA
05020	GOAT ROCK	CA	05736	MUSSELL SHOALS	CA	13113	KING AND PRINCE BEACH	GA
05021	WRIGHT'S BEACH	CA	05825	EAST BEACH	CA	13114	ST. SIMONS SCHOOL	GA
05022	STINSON BEACH	CA	05850	LEDBETTER	CA	15001	SUNSET BEACH	HI
05023	MANCHESTER BEACH	CA	05994	YELLOW ONE	CA	15010	HANALEI	HI
05024	VAN DAMME BEACH	CA	05995	SAN ONOFRE	CA	15200	BELLOWS AFS	HI
05025	RUSSIAN GULCH	CA	05996	OCEANSIDE	CA	15201	KUALOIA	HI
05026	MACKEERICHER	CA	05999	BORDERFIELD	CA	15202	HILO BAY FRONT	HI
05027	HUNTINGTON BEACH	CA	09001	SHERWOOD IS POINT	CA	17050	SHERIDAN	IL
05028	DOHENY BEACH	CA	09002	SHERWOOD IS WEST PT	CA	17090	ILLINOIS BEACH	IL
05029	SAN CLEMENTE	CA	09003	COMPO COVE FENCE	CA	18020	CENTRAL	IN
05039	NORTH CARLSBAD	CA	09004	COMPO COVE WEST	CA	18030	EAST PARK	IN
05031	SOUTH CARLSBAD	CA	09005	PROSPECT	CA	18040	STATE PARK	IN
05033	SAN ELIJO	CA	09006	PUMP STATION	CA	18050	OGDEN	IN
05034	TORREY PINES	CA	09007	SEAVIEW AVE	CA	22101	HOLLY BEACH	LA
05035	SILVER STRAND ST. PK.	CA	09008	SOUTH STREET	CA	22102	FONTAINE BLEAU	LA
05036	PRAIRIE CREEK REDWOOD	CA	10100	PICKERING BEACH	DE	23001	WILLARD BEACH	ME
05037	LONG BEACH, 65TH PLACE	CA	10101	KITTS HUMMOCK	DE	26001	ASSATEAGUE	MD
05110	IMPERIAL BEACH SOUTH	CA	10102	BOWERS BEACH	DE	26002	ASSATEAGUE NORTH	MD
05120	IMPERIAL BEACH NORTH	CA	10103	SLAUGHTER BEACH	DE	26003	ASSATEAGUE SOUTH	MD
05140	DEL MAR	CA	10104	BROADKILL	DE	26005	OCEAN CITY, 52ND ST.	MD
05185	BUHNE POINT	CA	10105	LEWES	DE	26009	SMITH ISLAND	MD
05300	NAVARRO	CA	10106	INDIAN RIVER INLET	DE	26995	CHESAPEAKE	MD
05301	SHELTER COVE	CA	12000	PERDIDO KEYS	FL	26997	POTOMAC	MD
05302	CENTERVILLE BEACH	CA	12001	K.A. HANNAH	FL	27004	LECOUNT HOLLOW	MA
05306	MAD RIVER	CA	12002	ATLANTIC BEACH	FL	27005	WASHBURN ISLAND	MA
05307	REDWOOD CREEK	CA	12003	SOUTH LAKE WORTH IN.	FL	27006	EEL POND	MA
05310	PELICAN	CA	12040	SOUTH PALM BEACH	FL	27007	BRANT ROCK	MA
05313	ENDERTS BEACH	CA	12041	JUPITER	FL	27008	NAUSET LIGHT	MA
05336	MISSION BEACH	CA	12042	BOCA RATON	FL	28002	NEW BUFFALO	MI
05355	DRAKE'S BEACH	CA	12043	HOLLYWOOD	FL	28005	WARREN DUNES	MI
05367	CAPITOLA BEACH	CA	12044	GOLDEN	FL	28010	VAN BUREN	MI
05401	VENTURA SITE 1	CA	12054	MARINELAND STAD.	FL	28020	GRAND HAVEN	MI
05402	VENTURA SITE 2	CA	12055	MARINELAND NORTH	FL	28025	HOFFMASTER	MI
05403	VENTURA SITE 3	CA	12056	MARINELAND QUALITY	FL	28030	MUSKEGON	MI
05411	ARROYO BURRO ST. PK.	CA	12057	MARINELAND SOUTH	FL	28035	SILVER LAKE	MI
05412	SHORELINE PARK	CA	12060	HAUOVER	FL	28040	MEARS	MI
05413	LEADBETTER BEACH	CA	12062	ALTOS DELMAR	FL	28045	LUDDINGTON	MI
05414	EAST BEACH	CA	12063	SMATHERS BEACH	FL	28050	ORCHARD	MI
05417	LOOKOUT PARK	CA	12064	INDIAN BEACH PARK	FL	28055	BENZIE (PLATT RIVER)	MI
05419	HOLLY AVENUE	CA	12066	LUMMUS PARK	FL	28060	D.H. DAY	MI
05500	BOLINAS	CA	12067	JENSON 2 NORTH	FL	28065	CHARLEVOIX	MI
05501	FISHERMANS WHARF WEST	CA	12068	JENSON 2 SOUTH	FL	28280	WELLS	MI
05502	FISHERMANS WHARF EAST	CA	12069	STUART 3 SOUTH	FL	28410	PORCUPINE	MI
05503	FISHERMANS WHARF PIER	CA	12070	MONROE A	FL	28420	ONTONAGON	MI
05560	ALAMEDA	CA	12071	MONROE B	FL	28430	MCLAIN	MI
05561	SYCAMORE	CA	12072	MONROE C	FL	28450	MARQUETTE	MI
05562	LINDA LANE	CA	12073	MONROE D	FL	28470	MUSKALLONGE	MI
05563	T STREET	CA	12074	MONROE E	FL	28480	TALQUAMENON	MI
05564	CARDIFF FLATS	CA	12080	ANASTASIA REC. AREA	FL	28490	BRIMELY	MI

**TABLE 1 (concluded) : LEO SITE LOCATIONS**

SITE	LOCATION	ST	SITE	LOCATION	ST
28630	HOEFT	MI	44500	PRESQUE ISLE	PA
28640	HARRISVILLE	MI	44501	PRESQUE ISLE #6	PA
28660	TAWAS	MI	44502	PRESQUE ISLE BCH 6	PA
28670	BAY CITY	MI	48002	CHERRY GROVE BEACH	SC
28675	SLEEPER	MI	48250	NORTH INLET	SC
28690	LAKEPORT	MI	48251	BULL ISLAND #1	SC
28750	METRO	MI	48252	BULL ISLAND #2	SC
28752	PORT SANILAC (SEC 11)	MI	48253	BULL ISLAND #3	SC
28753	SANILAC (SEC 26)	MI	48254	HUNTINGTON BEACH	SC
28850	STERLING	MI	48257	MURRELLS INLET	SC
30101	HORN ISLAND GULF	MS	48261	PORT ROYAL	SC
30103	SHIP ISLAND GULF	MS	48262	GRASSLAWN	SC
30104	SHIP ISLAND SOUND	MS	48263	PALMETTO DUNES	SC
36001	MANASQUAN INLET	NJ	48264	NIGHT HAWK	SC
36755	OCEAN CITY	NJ	48265	HILTON HEAD INN	SC
36989	CAPE MAY	NJ	48266	BAY BERRY	SC
38002	90TH ST. ROCKAWAY	NY	48267	SOUTH BEACH	SC
38004	JACOB RIIS PARK 2	NY	48270	KINGFISHER PIER	SC
38005	JACOB RIIS PARK 4	NY	48271	SURFSIDE HOLIDAY INN	SC
38006	OCEAN BEACH	NY	48272	MARLIN QUAY	SC
38007	WEST HAMPTON	NY	48273	FOLLY BEACH	SC
38008	EAST HAMPTON	NY	48275	N. LITCHFIELD BEACH	SC
38009	29TH ST. ROCKAWAY	NY	48276	LITCHFIELD BY THE SEA	SC
38010	94TH ST. ROCKAWAY	NY	51001	PADRE ISLAND	TX
38011	145TH ST. ROCKAWAY	NY	51002	PADRE SOUTH HOTEL	TX
38012	CATTARAUGUS CRK. SOTH.	NY	51010	SEA RIM	TX
38013	CATTARAUGUS CRK. NOTH	NY	51240	BRYON BEACH	TX
38014	CG STATION, 300FT EAST	NY	51244	SEA ISLE	TX
38015	GILGO UNDERPASS	NY	51246	GALVESTON	TX
38016	WEST GILGO	NY	51248	BERMUDA	TX
38017	PT. LOOKOUT STATION	NY	51250	EAST BEACH	TX
38018	COUNTY STATION	NY	51251	BOLIVAR	TX
38019	LIDO STATION	NY	51253	SWEDS	TX
39001	PEA ISLAND	NC	51255	GILCHRIST	TX
39010	SEA CREST	NC	51256	BEACH CITY	TX
39011	DUCK NORTH	NC	51257	SHORE ACRES	TX
39012	DUCK PIER	NC	51600	CORPUS CHRISTI	TX
39013	DUCK SOUND	NC	51601	CORPUS CHRISTI NORTH	TX
39014	AVALON PIER	NC	54004	BUCKROE BEACH	VA
39015	BOGUE SOUND	NC	54005	EAST OCEANVIEW	VA
39017	DUCK 1600 FEET	NC	54010	CENTRAL BEACH	VA
39019	SOUTHERN SHORES	NC	54011	CASTLEWOOD PARK	VA
39020	DUCK SOUTH	NC	57001	EDIS HOOK #1	WA
39098	OCEAN ISLE BEACH	NC	57002	EDIS HOOK #2	WA
39099	SUNSET BEACH	NC	57003	EDIS HOOK #3	WA
39322	CAPE POINT	NC	57004	EDIS HOOK #4	WA
39562	ATLANTIC BEACH	NC	57005	OAK HARBOR	WA
41001	LAKESHORE PARK 1	OH	57006	SUNNYSIDE BEACH	WA
41002	LAKESHORE PARK 2	OH	57007	SEAVIEW	WA
41003	LAKESHORE PARK 3	OH	57008	HOLMAN	WA
41004	LAKESHORE PARK 4	OH	57009	PEACOCK SPIT	WA
41008	GENEVA ST. PARK	OH	59010	ALFORD	WI
41009	LINWOOD PARK	OH	59011	APOSTLE ISLAND	WI
41010	LAKEVIEW PARK	OH	59012	ZIPPEL BAY	WI
41011	MAUMEE STATE PK	OH	59015	KENOSHA	WI
41012	PRESQUE ISLE #9	OH	59030	GRANT	WI
43001	FT. STEVENS	OR	59040	BRADFORD	WI
43002	BARVIEW BEACH	OR	59070	HARRINGTON	WI
43003	SOUTH BEACH	OR	59080	KOHLER-ANDRAE	WI
43004	NYE BEACH	OR	59100	HKA	WI
43005	UMPQUA SOUTH	OR	59120	POINT BEACH	WI
43006	HORSFAL BEACH	OR	59140	PORT WING	WI
43007	BASTENDORF	OR			
43008	AGATE BEACH	OR			
43009	HUBBARD CREEK	OR			
43010	BAILEY BEACH SOUTH	OR			
43011	AIRPORT BEACH	OR			
43013	SPORT HAVEN	OR			
43014	BAY OCEAN	OR			
43015	BULLARDS	OR			
43016	FACE ROCK	OR			
43017	HACETA	OR			
43018	GOOSE MARSH	OR			
43019	UMPQUA NORTH	OR			
43020	POINT ADAMS	OR			
43021	ROCK DOCK	OR			